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Summer emissions of nitrogen oxides from snow at Dome C (East Antarctica): a discussion of seasonal variability

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Field studies in the high and mid latitudes have demonstrated that surface snow can release significant amounts of nitrogen oxides (NO_x). Snow emissions of NO_x, mostly originating from UV-photolysis of nitrate, influence the oxidising capacity of the lower atmosphere above snow as well as the magnitude of snow denitrification, an important parameter for the interpretation of the nitrate record preserved in polar ice cores. However, open questions remain understanding the magnitude and variability of the NO_x snow-air flux in summer above Antarctica.

Here we present new observations of atmospheric nitrogen oxides ($NO+NO_2=NO_x$) carried out as part of the OPALE (Oxidant Production in Antarctic Lands & Export) project during December 2011 to January 2012 at Dome C, Antarctica (75.1ºS, 3233 m). NO_x flux estimates based on the flux-gradient method confirmed predominantly NO_x emissions from surface snow and showed up to three times higher values than those measured at the same site during Dec-2009 to Jan-2010. Flux uncertainties, measured snow chemical and physical properties, the turbulence of the atmospheric boundary layer and the total ozone column are analysed and their impact on the observed flux variability is discussed. Stratospheric ozone appears to be one of the key drivers explaining inter-seasonal variability in NO_x snow emission flux with important implications for year-to-year variability of the surface oxidant budget on the Antarctic Plateau.